

# Alabama Diphtheria Outbreak, 1967

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AFTER the introduction of diphtheria immunization in the 1920's, there was a decline in the incidence of diphtheria in Alabama parallel to that in the entire United States. However, in recent years, the incidence in Alabama and several other southern States has remained constant or increased (fig. 1). This paper is an analysis of 20 cases of diphtheria reported to the Alabama State Department of Public Health from August 2 through November 20, 1967.

## Methods

Each case was investigated by a physician or public health nurse. Immunization status and clinical severity were determined by Public Health Service criteria (1). Specimens from the throat, nasopharynx, or both, and from some skin lesions of household contacts of 19 of the 20 patients were cultured.

Cultures of specimens from two populations containing diagnosed cases of diphtheria were surveyed. The details of these surveys have been presented elsewhere (2).

In addition, during the 1967 outbreak in Alabama approximately 7,600 throat swab specimens which were cultured to identify streptococci were "screened" for *Corynebacterium diphtheriae*. Any growth on blood agar plates which was suggestive of *C. diphtheriae* was subcultured. Initial isolation, identification, and in vitro viru-

lence testing of *C. diphtheriae* organisms were done at the Alabama State Department of Public Health Laboratories (by Mrs. Mary Freear and Mrs. Opal Donahoo), and typing and confirmatory toxigenicity testing were done at the National Communicable Disease Center, Bacterial Serology Unit (by Mrs. Susan Bickham and Dr. Joseph A. Schubert), according to the methods of Frobisher (3).

## Findings

**Epidemiologic.** Figure 2 shows the location of the six counties from which cases were reported—Dallas, Montgomery, Marengo, Tuscaloosa, Jefferson, and Mobile. Table 1 shows the attack rates by county. They ranged from a high of 22.8 per 100,000 population in Dallas County to a low of 0.1 per 100,000 in Jefferson County. The epidemic curve is flat and quite symmetrical (fig. 3). Most of the Dallas County cases occurred on or before the midpoint of the 17-week outbreak whereas most of the cases in the other counties occurred later.

Of Alabama's 3,562,850 population in 1967, 2,536,200 were white and 1,026,550 were Negro. Five cases were reported in white persons and 15 in Negroes for attack rates of 0.2 and 1.5 per 100,000 population, respectively.

**Cases.** Table 2 contains a line listing of the diphtheria cases. The patients' ages ranged from 1 to 45 with a mean of 10.5

years. Sixteen of the 20 (80 percent) were between 1 and 10 years of age. All five fatal cases and both severe cases were in unimmunized persons. Two cases were moderately severe; the remaining 11 cases, including two in fully immunized children, were mild.

Patients 17 and 18 were mother and son. The mother had the onset of symptoms 4 days before the child, so it is possible that she was the source of his infection. A source could not be found in any other case.

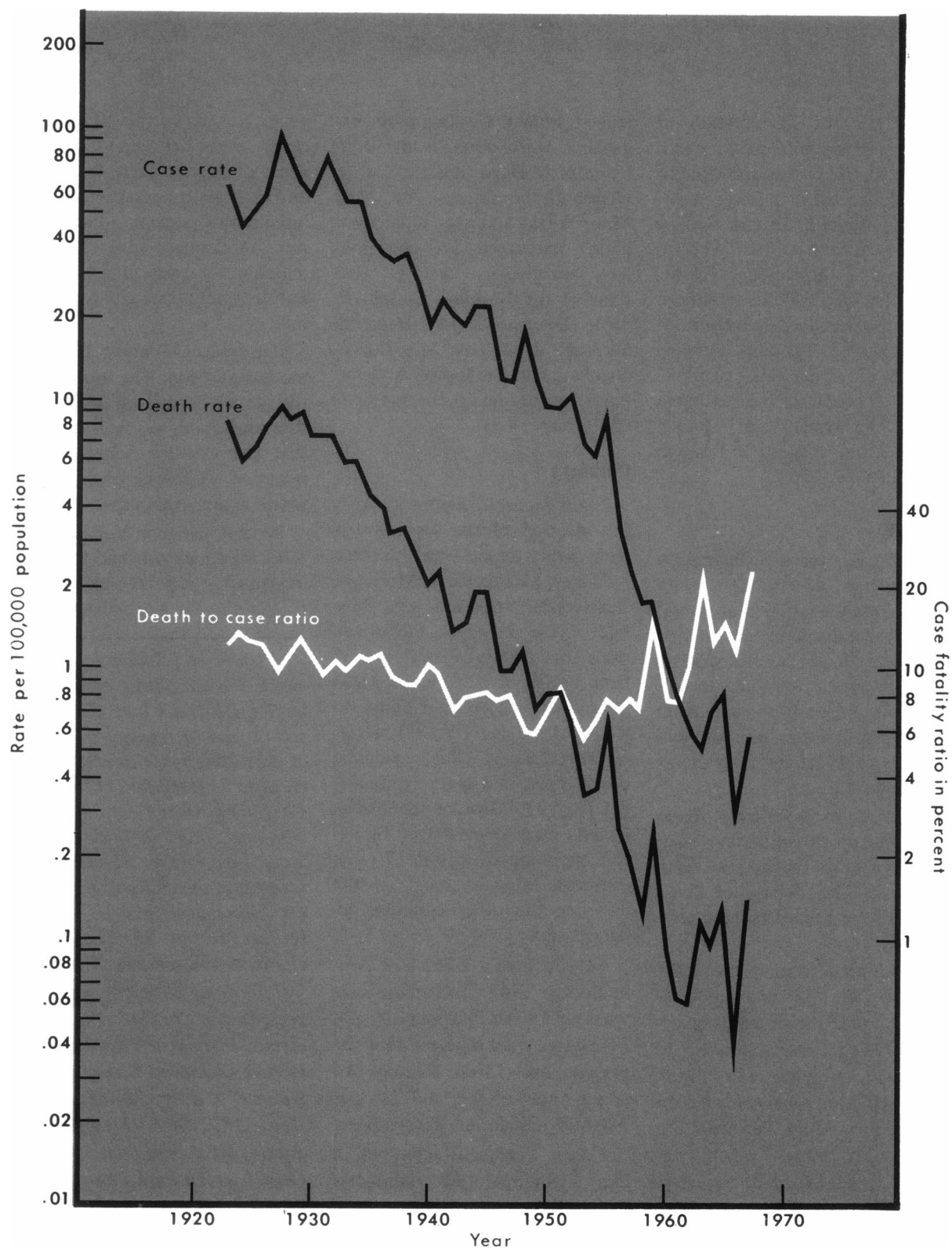
Sixteen patients had toxigenic *mitis* type and two had toxigenic *intermedius* type *C. diphtheriae*. *C. diphtheriae* was isolated from

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**Figure 1. Diphtheria-reported annual case and death rates, and case fatality ratio, Alabama, 1923-67**



patient 15 by a private laboratory where an in vitro virulence test was positive. A specimen was not submitted to the health department for confirmation. However, three of the patient's five family contacts had throat cultures positive for toxigenic *mitis* type *C. diphtheriae*.

Diphtheria was not bacteriologically confirmed in patient 19. Cultures obtained at autopsy were negative, but she had been treated with large doses of antibiotics for several days before she died. Cultures from three of her five family contacts were positive. Two siblings had toxigenic *mitis* type isolates, and the mother had both toxigenic *intermedius* and nontoxigenic *gravis* types of *C. diphtheriae*.

Patients often sought medical attention after several days of illness. The following cases are illustrative. Patient 13's condition was diagnosed as diphtheria when she was first seen by a physician on the fifth day of her illness with a "bullneck" and severe respiratory distress. She died 1 week later despite appropriate therapy.

Patient 17's condition was correctly diagnosed when she was brought to a physician's office after 1 week of symptoms. She had a "bullneck" and a membrane covering the entire oropharynx; she died of asphyxia before treatment could begin. Her son, patient 18, died without having seen a physician.

The conditions of nine patients were originally diagnosed as "strep throat." In one the correct diagnosis was made when the patient was taken to a large teaching hospital. She died despite intensive treatment. In another the diagnosis was made at autopsy. In two patients, diphtheria was suspected when their pharyngitis

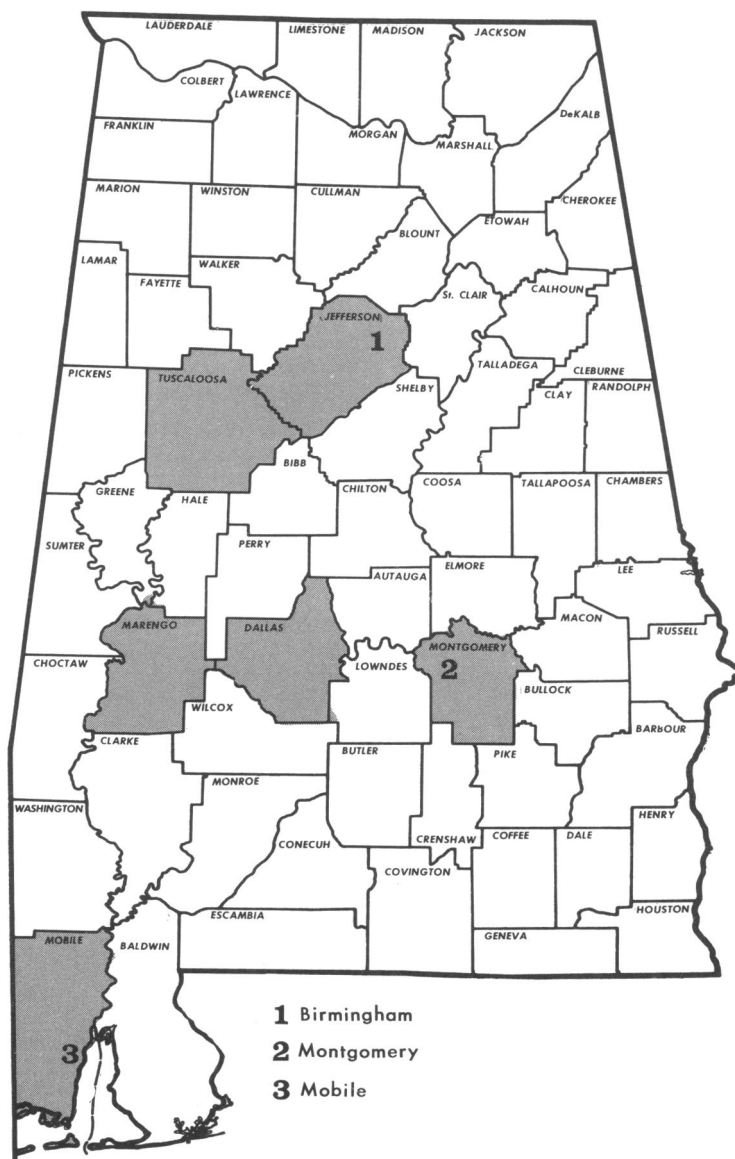
failed to improve after treatment with antibiotics. As for the other five patients, the diagnosis was made when *C. diphtheriae* organisms were fortuitously isolated from throat swab cultures for suspected streptococcal infections.

Patient 6, a 45-year-old farmer with cutaneous diphtheria, was previously reported (2). He had a painful month-old leg ulcer which initially appeared to be a staphylococcal infection. He had

no systemic symptoms. He received systemic and topical antibiotic therapy and the lesion healed slowly.

**Carriers.** Table 3 summarizes the carrier studies. Twenty-four carriers were found among the household contacts of 10 patients. In all severe and fatal cases, carriers were present in the households. In nine cases, no family carriers were detected; residents in one household were not studied. Thirty-seven addi-

**Figure 2. Counties reporting cases of diphtheria, Alabama, 1967**

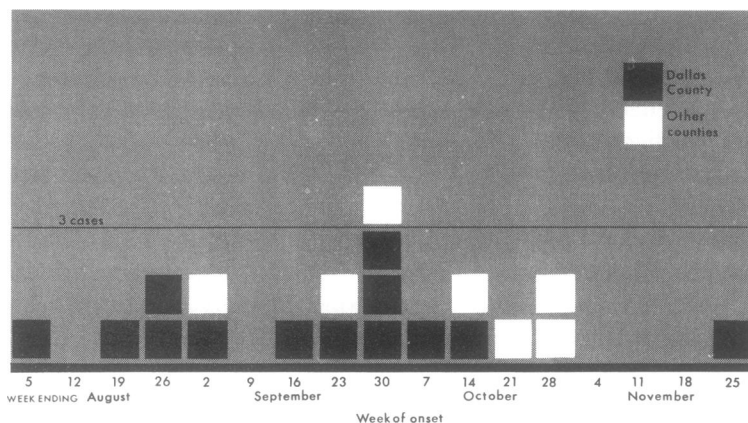


tional casual contact carriers (playmates, schoolmates, and work associates) were found in surveys. Twenty-three carriers, in addition to the five cases mentioned, were found through routine throat cultures performed to diagnose suspected streptococcal infections. None was epidemiologically related to cases of diphtheria.

*C. diphtheriae* isolated from carriers who were household contacts of patients were most often the same type and virulence as those found in the patients (*mitis* toxigenic). Carriers not epidemiologically related to cases had a much higher proportion of non-toxicogenic strains of other types of *C. diphtheriae*. Isolates from casual contacts were more like those of household contacts than non-contacts. The significance of these findings is not clear.

Eighty-four carriers were reported during the outbreak. Seventy-six were respiratory tract carriers, six were respiratory tract and skin carriers, and two were skin carriers only.

**Figure 3. Cases of diphtheria, by date of onset, Alabama, August-November 1967**



### Control Measures

When the first cases were reported from Dallas County, a review of the data from a recent

immunization survey showed low levels of adequate diphtheria immunization. A countywide immunization campaign was con-

**Table 1. Attack rates by county, Alabama diphtheria outbreak, 1967**

County	Population	Cases	Attack rate per 100,000
Dallas.....	57,100	13	22.8
Marengo.....	27,000	2	7.4
Montgomery.....	188,000	2	1.1
Tuscaloosa.....	118,400	1	.8
Mobile.....	366,900	1	.3
Jefferson.....	682,300	1	.1

**Table 2. Line listing of cases, Alabama diphtheria outbreak, 1967**

Case No.	Date of onset	Age (years)	Sex	Race	Immunization status	Clinical severity	County	Type <i>C. diphtheriae</i> isolated <sup>1</sup>
1.	Aug. 2	12	Male	Negro	Incomplete	Mild	Dallas	<i>Mitis</i>
2.	Aug. 18	10	Female	.....do....	.....do.....	Moderate	.....do.....	Do.
3.	Aug. 23	3	Male	.....do....	None	Mild	.....do.....	Do.
4.	Aug. 26	6	.....do....	White	Incomplete	.....do.....	.....do.....	Do.
5.	Sept. 1	10	.....do....	Negro	.....do.....	.....do.....	.....do.....	Do.
6. <sup>2</sup>	Sept. 1	45	.....do....	.....do....	None	.....do.....	Montgomery	Do.
7.	Sept. 12	8	Female	White	Full	.....do.....	Dallas	<i>Intermedius</i>
8.	Sept. 20	2	Male	Negro	None	.....do.....	.....do.....	Do.
9.	Sept. 22	7	Female	.....do....	.....do.....	Fatal	Mobile	<i>Mitis</i>
10.	Sept. 24	3	.....do....	.....do....	.....do.....	Mild	Dallas	Do.
11.	Sept. 25	8	.....do....	White	Full	.....do.....	.....do.....	Do.
12.	Sept. 26	19	.....do....	Negro	Incomplete	.....do.....	Montgomery	Do.
13.	Sept. 29	1	.....do....	.....do....	None	Fatal	Dallas	Do.
14.	Oct. 1	4	.....do....	.....do....	.....do.....	Moderate	.....do.....	Do.
15.	Oct. 10	4	Male	.....do....	.....do.....	Severe	Jefferson	Not tested
16.	Oct. 12	5	.....do....	.....do....	.....do.....	.....do.....	Dallas	<i>Mitis</i>
17.	Oct. 20	42	Female	.....do....	.....do.....	Fatal	Marengo	Do.
18.	Oct. 24	6	Male	.....do....	.....do.....	.....do.....	.....do.....	Do.
19.	Oct. 25	7	Female	White	.....do.....	.....do.....	Tuscaloosa	None
20.	Nov. 20	7	Male	.....do....	Lapsed	Mild	Dallas	<i>Mitis</i>

<sup>1</sup> Toxigenic.

<sup>2</sup> Case of cutaneous diphtheria.

**Table 3. Characteristics of *Corynebacterium diphtheriae* isolated from carriers, Alabama, 1967**

Type and toxigenity	Household contacts of patients	Casual contacts of patients	Not contacts of patients	Total
<i>Mitis</i> :				
Toxigenic .....	22	25	3	50
Not toxigenic .....	0	3	6	9
<i>Intermedius</i> :				
Toxigenic .....	1	3	0	4
Not toxigenic .....	0	0	0	0
<i>Gravis</i> :				
Toxigenic .....	0	0	1	1
Not toxigenic .....	2	7	8	17
Not determined, not toxigenic	0	2	5	7
Total .....	<sup>1</sup> 25	<sup>2</sup> 40	23	88

<sup>1</sup> 24 persons, 1 with 2 types of isolates.

<sup>2</sup> 37 persons, 3 with 2 types of isolates.

ducted. As cases occurred in other counties, immunization efforts varied from countywide to neighborhood and school programs. Approximately 40,000 injections of DTP (diphtheria and tetanus toxoids and pertussis vaccine), pediatric DT (diphtheria and tetanus toxoids, pediatric type), and adult TD (tetanus and diphtheria toxoids, adult type) were given, most with jet injector guns, with no known serious complications.

### Discussion

Despite the use of antitoxin, antibiotics, and sophisticated supportive care, the diphtheria case-

fatality ratio has remained constant at about 10 percent or has slightly increased (4). Late or nonexistent treatment probably explains the high mortality rate in this epidemic. Patients frequently consulted physicians late, and the conditions of at least nine were originally erroneously diagnosed.

Frank cases were the "top of the iceberg" representing about one-fifth of the total number of persons from whom *C. diphtheriae* were cultured (20 cases and 84 carriers). Carriers were easily found, especially among close contacts of patients, indicating that carrier rates during out-

breaks may be higher than is generally appreciated.

Diphtheria continues to be more prevalent in the South than in the remainder of the country. The seasonal pattern of diphtheria in southern States may reflect something regionally important in the basic epidemiology of the disease (2). For example, *C. diphtheriae* skin infections may be an important factor.

### REFERENCES

- (1) National Communicable Disease Center: Diphtheria surveillance. Report No. 7. Atlanta, Ga., June 1966, p. 19.
- (2) Belsey, M. A., Sinclair, M., Roder, M. R., and LeBlanc, D. R.: *Corynebacterium diphtheriae* skin infections in Alabama and Louisiana. A factor in the epidemiology of diphtheria. *N. Engl J Med* 280: 135-141, Jan. 16, 1969.
- (3) Frobisher, M.: Diphtheria. In *Diagnostic procedures and reagents: Techniques for the laboratory diagnosis and control of communicable diseases*. Ch. 8. Edited by A. H. Harris and M. B. Coleman. Ed. 4. American Public Health Association, New York, 1963, pp. 231-260.
- (4) National Communicable Disease Center: Epidemiologic notes and reports. Diphtheria—Alabama. *Morbidity and Mortality Weekly Report*, vol. 16, No. 41, week ending Oct. 14, 1967, pp. 345-346.

SINCLAIR, MICHAEL C. (Los Angeles County Harbor General Hospital, Torrance, Calif.), OVERTON, RAYMOND, and DONALD, WILLIAM J.: *Alabama diphtheria outbreak, 1967. HSMHA Health Reports, Vol. 86, December 1971, pp. 1107-1111.*

Twenty cases of diphtheria and 84 carriers were reported in Alabama between August 4 and November 20, 1967. Thirteen cases occurred in Dallas County. Eighty percent of the cases were in children between 1 and 10 years of age. Five deaths occurred in unimmunized persons. Treatment was frequently delayed or completely absent, and in several instances the original diagnosis was incorrect.

The 84 carriers and 20 cases indicate a high incidence of colonization without clinical illness. Forty thousand doses of diphtheria and tetanus toxoids and pertussis vaccine; diphtheria and tetanus toxoids, pediatric type; and tetanus and diphtheria toxoids, adult type were administered without any known serious complications and perhaps without altering the course of the epidemic.